

SYLLABUS ENTO/WFSC 489/689

Ecology & Bioassessment of Freshwater Environments

Dr. Anthony Cognato (ENTO. Sec. 501) & Dr. Fran Gelwick (WFSC. Sec 502)

205 Heep Center (lecture & lab)

Lecture MWF 1:50 - 2:40 Laboratory W 2:50 - 5:40

Instructors:

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Course Description: This course provides the basic ecological knowledge and theories concerning the structure and functional integrity of freshwater environments, and the practical skills and experience with methods used to assess biological components relevant to water quality and ecosystem health. Student learning will be reinforced through a field project designed to integrate student knowledge about ecological and biological relationships. Students will synthesize new information, critically evaluate results, and present their conclusions and supporting evidence concerning ecosystem health and integrity for the target watersheds using written, visual, and oral communication skills. Lecture and Laboratory content is detailed below.

Lectures address the question "*How do the patterns and processes occurring in and influencing aquatic ecosystems affect their biotic communities?*". Patterns include channel structure and in-stream habitats, watershed land use, and invertebrate and fish community structure. Processes include channel formation, nutrient cycling and downstream transport, trophic dynamics, plant and animal colonization and succession, community dynamics, and the impacts of natural and anthropogenic disturbances. In order to complete the curriculum on aquatic ecosystems and application of knowledge for management, lectures will integrate ecological and evolutionary themes by providing detailed information about animal life histories, and functional morphology.

Laboratory provides the practical skills and education in sampling design and protocol needed for bioassessment of aquatic health. It has two components.

First is the identification of aquatic biota. Laboratory periods will include taxonomy; use of dichotomous keys and identification of orders, families, genera, and selected target species (primarily fishes) from regional systems will be expected. A strong background in taxonomy is necessary to comply with Environmental Protection Agency (EPA) protocols for water quality assessment. Taxonomic knowledge is indispensable for those that plan for employment in the fields of Bioenvironmental Sciences, Entomology, Rangeland Ecology and Management, and Recreation, Parks and Tourism Sciences, and Wildlife and Fisheries Sciences. Taxa will also be presented as functional feeding groups to integrate ecological function (presented in lecture) and form. A local collection of aquatic invertebrates will be required.

Second is a field project designed to teach techniques of biomonitoring, and data collection to test hypotheses related to environmental assessment. Sampling design and data analysis will follow EPA guidelines. The field project will be an in-depth inventory of streams

near Campus. Four labs will be used to obtain field data. Streams will represent contrasting watershed conditions (e.g., urban and agriculture), and an undisturbed reference stream. The reference stream will be re-sampled on each field trip to study temporal variability. Lab data collection and data analysis will be accomplished during four laboratory periods.

Four written field reports will be required (one after each completed field survey). After data from all field trips have been summarized and analyzed, students will write a preliminary draft of their term report. The term report will assess biological integrity and ecological health of test streams and temporal variability of the reference stream in the format of a scientific report (i.e., Summary, Introduction, Methods, Results, and Conclusions). The instructors will evaluate these drafts, and hold editorial conferences with each student to discuss ways to enhance the justification and presentation of their conclusions. We will then conduct an Evening Professional Symposium and Social during which each lab group will present the results of a subset of the project. Students then will revise and resubmit a final draft of their term report. Below is the approximate schedule of field and lab activities:

In the field

- Watershed overview of sites, sketch, flag sites, take water, algae/plant samples, and field notes
- Characterization of instream and riparian habitat features
- Sampling invertebrate populations
- Sampling fish populations

In the laboratory

- Mapping the drainage basin and analysis of USGS discharge data [or calculation of discharge for ungauged streams].
- Analysis of habitat data for each site, and for repeated sampling of reference site
- Invertebrate identification, enumeration, and calculation of bioassessment indices
- Fish identification and calculation of bioassessment indices
- Lab groups meet to organize symposium presentations
- Evening symposium
- An optional over-night field trip will be scheduled to survey biodiversity and habitat variation across several ecoregions.

Prerequisites: BIOL 114/124, or BOTN 101 and ZOOL 107, or approval of instructor.

Required texts (3):

1. Allan, J.D. 1995. Stream ecology: structure and function of running waters. Chapman and Hall, NY, NY. (This is the best available, up-to-date summary of stream ecology and will serve as a reference text. Good for future reference in this field.)
2. Merritt, R. W., and K.W. Cummins 1996. An introduction to the aquatic insects of North America (3rd ed). Kendall Hunt Publishing Co., Debuque, IA. (A must for the laboratory because it is the best available field guide to aquatic insects.)
3. Hubbs, C., R. J. Edwards, G. P. Garrett. 1991. An annotated checklist of the freshwater fishes of Texas, with keys to identification of species. Texas Journal of Science Vol 43 (4) Supplement.

Other required readings will be distributed in class or will be available in a Readings Outline on Reserve in Evans Library. The Readings Outline serves as a useful guide, with opportunity for additions, deletions, and substitutions that will be announced and provided as necessary during the semester.

Examples:

- Fontaine, T.D. & S.M. Bartell. 1983. Dynamics of Lotic Ecosystems. Ann Arbor Science.
- Hauer, F. R., & G. A. Lamberti. 1996. Methods in Stream Ecology. Academic Press Inc.
- Hynes, H.B.N. 1970. The Ecology of Running Waters. Univ. Liverpool.
- Stanford, J. A., & A. P. Covich. 1988. Proceedings of a symposium on community structure and function in temperate and tropical streams. J. N. Am. Benthol. Soc. 7: 261-529.
- Resh, V.H. & D.M. Rosenberg. 1984. The Ecology of Aquatic Insects. Praeger.
- USEPA. 1999. Rapid Bioassessment Protocols for Use in Wadeable Streams and Rivers. 2nd edition. EPA 841-B-99-002
- USEPA 1998. Lake and Reservoir Bioassessment and Biocriteria: Technical Guidance Document. EPA 841-B-98-007

References to web sites:

- EPA Bioassessment: <http://www.epa.gov/ost/biocriteria/index.html>
- EPA Bioindicators: <http://www.epa.gov/bioindicators/>
- EPA Environmental Monitoring and Assessment Program: <http://www.epa.gov/emap/>
- EPA Biocriteria Case Studies: <http://www.epa.gov/waterscience/biocriteria/casestudies/>

TCEQ (TNRCC) Surface Water Quality Monitoring (SWQM) Procedures Manual:
<http://www.tnrcc.state.tx.us/admin/topdoc/gi/252.html>

TCEQ (TNRCC) Receiving Water Assessment Procedures Manual:
<http://www.tnrcc.state.tx.us/admin/topdoc/gi/253.pdf>

TPWD 2002 Regionalize IBI for Texas:
http://www.tpwd.state.tx.us/texaswater/river_studies/index.htm

USGS Open-File Report 93-104: Methods for Sampling Fish Communities as a Part of the National Water-Quality Assessment Program
<http://water.usgs.gov/nawqa/protocols/OFR-93-104/fish1.html>

USGS Open-File Report 93-406: Methods for Collecting Benthic Invertebrate Samples as Part of the National Water-Quality Assessment Program
<http://water.usgs.gov/nawqa/protocols/OFR-93-406/inv1.html>

Grading:

Exam I	100 points.
Exam II	90 points.
Exam III	60 points.
Practical I	100 points.
Practical II	100 points.
Practical III	50 points.
* <i>Aquatic Insect Collection</i>	100 points (30 extra points may be earned by adding invertebrates from a supplemental list).
* <i>Field Project Final Report</i>	100 points (30 extra points may be earned by adding suggested enhancements).
Total	700 points.

A = \geq 630 points (90%)

B = \geq 560 points (80%)

C = \geq 490 points (70%)

D = \geq 420 points (60%)

F = \leq 410 points (50%)

**Collection and Field Project report requirements and grading scheme will be detailed in a separate hand-out during the course.*

Americans with Disabilities Act (ADA) Policy Statement

The Americans with Disabilities Act (ADA) is a federal anti-discrimination statute that provides comprehensive civil rights protection for persons with disabilities. Among other things, this legislation requires that all students with disabilities be guaranteed a learning environment that provides for reasonable accommodation of their disabilities. If you believe you have a disability requiring an accommodation, please contact the Department of Student Life, Services for Students with Disabilities, in Room 126 of the Koldus Building or call 845-1637.

Academic Integrity Statement**Aggie Honor Code**

"An Aggie does not lie, cheat, or steal or tolerate those who do."

Please refer to the Honor Council Rules and Procedures on the web
<http://www.tamu.edu/aggiehonor>

For all assignments and exams you will be required to sign the following:

"On my honor, as an Aggie, I have neither given nor received unauthorized aid on this academic work."

Signature of student

**Approximate Lecture and Laboratory Schedule for
ENTO/WFSC 489 Ecology and Bioassessment of Freshwater Environments:**

WEEK 1 -January

1. Introduction to lecture and lab aspects of course - **A&F**
2. Insect Phylogeny & Classification **Anthony**
Laboratory: How to use a taxonomic key; Insect Orders
3. Aquatic Sampling and Statistical Methods **Fran**

WEEK 2 - January

4. Mayfly life history & Diversity **Anthony**
Laboratory: Mayflies: species-environment relationships.
5. Bioassessment in Aquatic Ecosystems: overview **Fran**
Clean Water Act, Indices of Biological Integrity,
6. Bioassessment in Aquatic Ecosystems: overview **Fran**
EPA-EMAP, USGS-NAWQA, TCEQ, Invertebrates and Fish as Indicators

WEEK 3 - January

7. Aquatic habitats I: chemical characteristics - **Fran**
Important adaptations by biota; tolerance, cues
8. Dragonfly life history - **Anthony**
Laboratory: Dragonflies & Stoneflies species-environment relationships
9. Predators I & Omnivores I: Dragonfly & Stonefly diversity - **Anthony**

WEEK 4 - February

10. Aquatic habitats II: physical characteristics - **Fran**
Important adaptations by biota; behavior, cover, refuge, movement
11. Field trip I introduction - **A&F**
Laboratory: Field trip I: Reference Stream and agricultural stream I-A&F
12. Stonefly life history - **Anthony**

WEEK 5 - February

13. Aquatic patterns and processes: **Fran**
I. Patterns - Spatial zonation and temporal seasonality
Important adaptations by biota; movement, feeding, reproduction
14. Caddisfly life history - **Anthony**
Laboratory: Caddisflies, species-environment relationships
15. Omnivores II: Caddisfly diversity **Anthony**

WEEK 6 - February

16. **Exam I** (Lectures 1-15).Fran Gone - **Anthony**
17. True Bugs life history Fran Gone - **Anthony**
Laboratory: Lab Practical I (over wks 1-5) taxonomy and environmental relationships
True Bug environmental relationships.
18. Piercing & Sucking: True Bug diversity - **Anthony**

WEEK 7 - February

19. Aquatic patterns and processes II: processes - **Fran**
energy and nutrient cycling, colonization, succession, important adaptations
20. Field trip II introduction - **A&F**
Laboratory: **Field trip II: Reference stream and agricultural stream II - A&F**
21. Non-insect (arthropods) bio-indicators **Anthony**

WEEK 8 - March

22. Habitat-Trophic relationships I: autotrophy, herbivores, grazers, filterers - **Fran**
23. Megaloptera and Beetle life history - **Anthony**
Laboratory: Megaloptera species-environment relationships & Omnivores III: Beetle diversity & environmental relationships
24. Predators II: Megaloptera diversity - **Anthony**

WEEK 9 - Spring Break March 14-18th

WEEK 10 - March

25. Habitat-Trophic relationships II: heterotrophy, microbial loop, detritivores, scrapers, shredders, collector-gatherers, filterers - **Fran**
26. Fly life history; Field trip III introduction - **A&F**
Laboratory: **Field trip III: Reference stream and urban stream I - A&F**
27. Omnivores IV: Fly diversity **Anthony**

WEEK 10 - March

28. Habitat-Trophic relationships III: heterotrophy, carnivory, benthic, water column, surface feeding.- **Fran**
29. Field trip IV introduction - **A&F**
Laboratory: **Field trip IV: Reference stream and urban stream II - A&F**
30. Flies species-environment relationships - **Anthony**

WEEK 11 - March - April

31. **Exam II** (over lectures 17-30) - **Fran**
32. Life Histories: periodic, equilibrium, opportunistic - **Fran**
Laboratory: **Lab Practical II** (over wks 6-10); Specimen identification, data entry and analysis.
33. March 25 NO CLASS - attend class on Tues May 3rd redefined day (see below)

WEEK 12 – April

34. Fly Life Histories – **Anthony**;
35. Fish life histories I
Laboratory: Fishes species-environment relationships, data entry and analysis. **Fran**
36. Fish diversity and their functional feeding groups I

WEEK 13 - April

- 37. Community response to natural disturbance regimes: colonization Succession, River Continuum and Flood Pulse Concepts - **Fran**
- 38. Fish life histories II Fish diversity and their functional feeding groups II - **Fran**
Laboratory: Fish species-environment relationships, data entry and analysis
- 38. Community response to human disturbance I: physical alterations
Land use, Channel modification, Serial Discontinuity Concept. - **Fran**

WEEK 14 - April

- 40. Community response to human disturbance II: chemical and biological alterations
Eutrophication, Climate change, Nonnative species - **Fran**
- 41. Laboratory: Practical III (over wks 12 & 13) Free to work on collections or reports.
- 42. **Exam III** (over lectures 32-40) **Student conferences, work on reports**

WEEK 15 - April - May

- 43. Mon - Dead day, classes, but no exams.
- 44. Tues – May 3rd redefined day, attend for Friday March 25th
STUDENT SYMPOSIUM & SOCIAL (~1hr)
- 45. Wed - No Class
- 46. Fri - No Class

Your final is the written report, due in Dr. Cognato's Office during the schedule time for our final exam: Monday May ? 10:30am-12:30pm (finals schedule not published as yet).